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# PRODUCTION FACTOR USE EFFICIENCY OF MAIZE FARMING IN DRYLAND AREAS

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**ABSTRACT**

This study aimed to determine the amount of income, the effect of the use of production factors, and the level of efficiency of the use of production factors using the allocative efficiency approach in corn farming in Oemasi Village, Nekamese Sub District, Kupang Regency. The research location was chosen purposively (purposive sampling) and the sample was determined using simple random sampling of as many as 53 respondents. The types of data collected are primary data and secondary data, using the methods of observation, interviews, and documentation. This research was conducted from May to June 2022. The results showed that the income earned by corn farmers was Rp. 105,460,607 per growing season or Rp. 4,859,936/ha. Five production factors are directly related and have a significant effect on corn production in Oemasi Village, Nekamese District, Kupang Regency, namely land area, seeds, and fertilizers, while pesticides and labor are related but not significantly. The results of the allocative efficiency analysis show that the use of land, seed, and pesticide production factors is not yet efficient so it needs to be added to its use, while fertilizer and labor production factors are inefficient so their use needs to be reduced.

**KEYWORDS:** Farming, maize, Income, Factors of production, allocative, efficiency.

## 1. INTRODUCTION

Maize is one of the food crop commodities that contributes to the growth of the agricultural sector. After rice, maize is Indonesia's main source of carbohydrates. Maize is additionally utilized as animal feed. Along with rising economic standards of living and developments in the animal feed sector, maize demand rises steadily from year to year.

In order to meet the needs of food and industry and provide chances for open employment to raise farmers' living standards, the growth of maize commodities plays a crucial role in the food security system and as a driver of the national economy (Husodo, 2004).

West Timor, especially Nekamese Sub District, is an area where the majority of the population work as farmers because it is supported by an area with potential in dryland agriculture, and one of the potential agricultural products to be developed is corn. However, based on data recorded at the Central Bureau of Statistics, maize production in this area fluctuated from 2017 to 2020 (BPS, 2021) Overall from 2017 to 2020, the maize productivity of Nekamese District fluctuated. In 2017, maize production was 1,611.8 tonnes, with a productivity of 2.0 tonnes/ha. In 2018, there was an increase in productivity to 4.1 tonnes/ha; in the following year 2019, it decreased to 3.2 tonnes/ha and continued to decrease to 2.5 tonnes/ha in 2020.

This is also the case for maize productivity in the sample village of Oemasi. Oemasi is one of the villages in the Nekamese sub-district, Kupang district. Maize productivity in Oemasi village in 2021 was only 1.4 tonnes/ha. Farming success is also influenced by production factors (capital, land, labor). Capital is needed for buying production facilities (seeds, fertilizers, pesticides, and equipment), crop maintenance costs, storage, marketing, and transportation. Farmers often experience problems in increasing farm yields by increasing the land area and procuring production facilities (Darmawaty, 2005).

The best alternative combination of production factors such as land, seeds, pesticides, fertilizers, and labor, as well as the costs incurred and many other production factors that need to be taken into consideration in order to have an impact on the production and income of farmers, determines fluctuations in maize production. The

average revenue level for a farmer in Oemasi Village, Nekamese District, and Kupang Regency throughout a season is low at IDR 5,856,999, which is due to the region's low maize output (Punga et al., 2020).
To ascertain the amount of farmers' income, the impact of production factors' use on production, and the efficiency of those production factors' used in corn growing in the dryland region of Oemasi Village, Nekamese Sub-District, West Timor, this study was carried out.

## 2. METODE PENELITIAN

This study was conducted in the dryland region of Oemasi Village, Nekamese Sub-District, West Timor to determine the amount of farmers' income, the effect of production factors' usage on production, and the degree of efficiency of those factors' use in corn growing.

**Data analysis method**

In farming, it is inseparable from the costs incurred during the activities carried out, including fixed costs and variable costs. So to find the cost of production is known as the total cost. With the following formula:
TC = TFC + TVC
Where :
TC = Total Costs
TFC = Total Fixed Costs
TVC = Total Variable Costs

Farmers' income is obtained from the difference between total revenue and total costs. While the revenue is calculated using the following formula:

TR = Q x P
Description:
TR = total revenue
Q = amount of production
P = commodity price
If the revenue is known, the farmer's income is calculated by the following formula:
I = TR - TC

Where:
I = income
TR = Total revenue
TC = Total production cost

To determine the effect of production factors on maize production in the study location, multiple linear regression analysis with Cobb-Douglass production function can be written more specifically as follows::
$Y = \alpha + X1^{\beta 1}\ X2^{\beta 2}\ X3^{\beta 3}\ X4^{\beta 4}\ X5^{\beta 5} + e$

Due to the difference in units and magnitude of the independent variables, this regression equation must be transformed into the form of a natural logarithm model. The reason for choosing the natural logarithm according to (Ghozali, 2005) is to avoid heteroskedasticity and know the coefficient that shows elasticity and brings the data scale closer. Thus, the equation is transformed into the following equation:

$\text{Ln } Y = \text{Ln } \alpha + \beta_1 \text{ Ln } X_1 + \beta 2 \text{ Ln } X2 + \beta 3 \text{ Ln } X3 + \beta 4 \text{ Ln } X4 + \beta 5 \text{ Ln } X5 + e$
Where:
Y= Corn Yields (kg)
α= Constanta
β1.β5= Regression coeficients
X1= land area (Ha)
X2= seeds (Kg)
X3= fertilizers (Kg)
X4= laborers (MWD)
X5= pesticides (l)
e = error terms

Before estimating multiple regression models, the data used must be ensured to be free from classical assumption deviations for multicollinearity, heteroscedasticity, and autocorrelation (Gujarati, 2003). Hypothesis

testing is a temporary conjecture that becomes a temporary answer to the research problem for which the t-test and F-test are carried out with the following hypotheses:

1. H0 = independent variables either simultaneously or partially have no significant effect on the dependent variable (Y).
2. H1 = independent variables both simultaneously and partially have a significant effect on the dependent variable (Y).

To see whether the allocative use of inputs is efficient or not can be detected through the marginal production value (NPM) with the formula recommended by Soekartawi (2002):

NPM= $b \frac{Y.PY}{X}$

Where:

b = production elasticity

Y= Production

Py = Production price

X = number of factors of production

The condition that must be fulfilled for allocative efficiency to be achieved is that NPMx is equal to the price of production factors (Px), and it can be written as follows:

$\frac{b.Y.Py}{X} = Px$ atau $\frac{b.Y.Py}{PX} = 1$

The marginal production value (NPM) of the production factor (Xi) can be calculated as follows:

$$NPM_{xi} = b_{xi} \frac{Y.P_y}{X_i.P_{xi}}$$

Dimana :

b = Produksi elasticity

Y = Production

Py = Production price

X = Inputs

Px = harga faktor produksi

Maka dari itu, dapat ditemui sebagai berikut:

- $\frac{b.Y.Py}{X.Px} < 1$ which means that the use of production factor X is considered inefficient.
- $\frac{b.Y.Py}{X.Px} = 1$; which means that the use of production factor X is efficient.
- $\frac{b.Y.Py}{X.Px} > 1$; which means that the use of production factor X is not yet efficient..

## 3. RESULTS AND DISCUSSION

**Total Cost of Maize Farm Production**

Total production costs in maize farming include fixed and variable costs. The fixed cost component is calculated from the depreciation value of farmer-owned equipment and land tax used in maize farming.

Table 1. Production Cost Components of Maize Farming

| Components | Total Costs | |
|---|---|---|
| | Per planting season (Rp) | Per hectare (Rp/ha) |
| **Fixed costs** | | |
| 1. equipment depreciation | | |
| Machete | 571.375 | 26.331 |
| Scythe | 437.124 | 20.144 |
| Hoe | 468.393 | 21.585 |
| Sprayer | 3.104.500 | 143.064 |
| 2. Land Tax | 2.489.000 | 114.700 |
| **Total Fixed Costs** | **7.070.392** | **325.824** |
| Variable costs | | |
| Seeds | 4.545.000 | 209.447 |
| Fertilizers | 7.669.000 | 353.410 |
| Pesticides | 4.375.000 | 201.613 |
| Labor | 38.100.000 | 1.755.760 |
| Transportations | 4.220.000 | 194.470 |

| | | |
|---|---|---|
| **Total Variable Costs** | **58.909.000** | **2.714.700** |
| **Total Biaya (TC)** | **65.979.392** | **3.040.524** |

*Source: Primary data, 2022*

Based on the table above, the total cost incurred during one period of corn farming was Rp. 65,979,392, and the total cost incurred for corn farming per hectare was Rp. 3,040 524, which consisted of fixed costs of Rp. 7,070,392 and variable costs of Rp. 58,909,000.

**Corn Farm Revenues**

The amount of revenue received by farmers can be seen from the amount of production and the unit price of production produced, the smaller the farm receipts.

Based on Table 2, it is known that the total revenue of corn farmers in Oemasi Village was Rp. 171, 440,000 per growing season, and Rp. 8,048,826/ha with a sale price of Rp. 4,000 per kg. The amount of income of the farmers in Oemasi village depended on the maize yield and the selling price at the time (Table 2).

**Table 2. Maize Farming Revenue**

| Components | One planting season | Per hectare (Rp/ha) |
|---|---|---|
| Total Production (Kg) | 42.860 | 2.012 |
| Price (Rp/kg) | 4.000 | 4.000 |
| **Total Revenue** | **171.440.000** | **8.048.826** |

*Source: Primary data processed, 2022*

Farm income is the difference between total farm income and total farm costs (Table 3).

**Table 3. Maize Farming Income**

| Components | Per planting season (Rp) | Per hectare (Rp/ha) |
|---|---|---|
| A. Total Revenue | 171.440.000 | 8.048.826 |
| B. Total Costs | 65.979.392 | 3.040.524 |
| **Income (A-B)** | **105.460.607** | **4.859.936** |

*Source: Primary data processed, 2022*

Based on the table above, it can be concluded that the total revenue (TR) of maize farmers is greater than the total cost (TC) incurred by farmers during production activities. Therefore, maize farming income in the research site is profitable for farmers, so a total income of Rp. 105,460,607 or Rp. 4,859,936/ha can be obtained.

**Multiple Linear Regression Analysis**

The results of data calculations using multiple linear regression analysis with SPSS 25 tools obtained regression equations for corn production factors in Oemasi Village, Nekamase Sub-District, Kupang Regency. The results is presented in the Table 5:

**Table 4. Estimation Results of Regression Coefficients on the Use of Maize Production Factors**

| Production Factors | Coef/ Elastis | $T_{stat}$ | $t_{table}$ | $F_{stat}$ |
|---|---|---|---|---|
| Land (X1) | 0.303 | 2.128 | 2.012 | 25.184 |
| Seeds (X2) | 0.526 | 4.012 | | |
| Fertilizers (X3) | 0.228 | 2.179 | | |
| Pesticides (X4) | 0.112 | 0.864 | | |
| Labor (X5) | 0.182 | 1.253 | | |
| Constanta | 4.826 | 6.324 | | |
| $R^2$ | 0.728 | | | |
| Adjusted R | 0.699 | | | |

*Source: Primary data, 2022*

1. Land
   The regression coefficient for the land factor (X1) is 0.303, which is positive and indicates that every 1 percent increase in the land area will increase production by 0.303 percent, assuming other variables are constant, and the t-count of 2.128 is greater than the t-table, which means that land area has a significant effect on maize production (Y) H0 is rejected H1 is accepted, at the 5% confidence level, because the land is a factor that determines a lot of maize production.
2. Seeds
   The regression coefficient value for the Seed factor (X2) is 0.526 which is positive and gives a real influence at the 5% level indicating that every 1 percent increase in seeds will increase the amount of production by 0.526 percent assuming other variables are considered constant. This means that every amount of seed use increases can increase production. As well as obtained a t-stat of 4.012 greater than the t-table which means the seed is a highly significant effect on maize production (Y) H0 rejected H1 accepted, at a confidence level of 5%, with a regression coefficient of 0.526.
3. Fertilizer
   The regression coefficient value for the Fertiliser Seed factor (X3) is 0.228 which is positive which gives a real influence and shows that every 1 percent increase in fertilizer will increase the amount of production by 0.228 percent assuming other variables are considered constant. According to the results of previous research (Muliyanti et al, 2019) stated that fertilizer has no effect and has a positive sign. The coefficient of fertilizer is 0.024, meaning that the use of fertilizer increased by 1 percent will increase production by 0.024 percent. Fertiliser (X3) obtained a t-count of 2.179 greater than the t-table which means that the seed has a significant effect on maize production (Y) H0 rejected H1 accepted, at a confidence level of 5%, with a regression coefficient of 0.228.
4. Pesticide
   The regression coefficient for the pesticide factor (X4) is 0.112 which is positive and indicates that every 1 percent increase in pesticides will increase production by 0.112 percent assuming other variables are constant. However, the t-test results that the t-count of 0.864 is smaller than the t-table of 2.012 which means it shows that pesticides have no significant effect on maize production at the 5% confidence level. The regression coefficient also illustrates the value of Production Elasticity (Ep), so the value of pesticide production elasticity (X4) is 0.112.
5. Labor
   The regression coefficient for the labor factor (X5) is 0.182 which is positive, meaning that the labor variable exerts a real influence and indicates that every 1 percent increase in labor will increase the amount of production by 0.182 percent assuming other variables are considered constant. The t-test result that the t-count of 1.253 is smaller than the t-table of 2.012 which indicates that the labor variable partially does not have a significant effect on maize production at the 5% confidence level. According to Taebenu (2019), the production factor of labor has a positive and insignificant effect at the 95% confidence level on the production of paddy rice. With a regression coefficient value on the variable of 0.031672, it means that every 1% increase in labor will increase the value of rice production by 0.03%, assuming that other factors remain constant. The results of Mahfud et al. (2019) reveal that the use of labor decreases production because the use of labor is too much, causing the costs incurred to pay labor wages to be greater.

The constant value of the maize commodity production function is 4.826, which means that where the use of factors that affect maize production, the value of demand for maize production is 4.826 Kg. The constant value shows that land area, seeds, fertilizers, pesticides, and labor do not change or can still determine the amount of corn production.

The coefficient of determination R Square ($R^2$) is used to determine the magnitude of the variable factors of production of corn commodities caused by the influence of variables that determine the production of corn commodities. Judging from the value of $R^2$ in the table above that the value of $R^2$ is 0.728 which explains the magnitude of the relationship between the independent variable to the dependent variable is very strong. From the output results, the coefficient of determination ($R^2$) is 72.8%, meaning that the independent variable affects the dependent variable (production), while the remaining 27.2% is influenced by factors outside the variable.
The adjusted coefficient of determination ($R^2$Ajusted) is used to determine the effect of the number of variables on maize production. With a value of 0.699, it means that 69.9% of maize production is influenced by the number of factors included in the model while the remaining 30.1% is influenced by other factors outside the model.

**Allocative Efficiency Analysis**

Knowing the allocative efficiency of maize production from the use of production inputs, first know the average costs incurred from each production factor such as land area (X1), seeds (X2), fertilizers (X3), pesticides (X4), and labour (X5), as well as the price of production and the value of marginal products (NPMxi) can be seen in the following table:

**Tabel 5. Nilai Efisiensi Alokatif Penggunaan Faktor-Faktor Produks Jagung**

| Input | Regression coeficient | Y | Py | Xi | Pxi | NPMxi/Pxi | Description |
|---|---|---|---|---|---|---|---|
| Land | 0,303 | 808,68 | 4.000 | 0,409 | 46.962 | 51,028 | Not yet Efficient |
| Seeds | 0,526 | 808,68 | 4.000 | 2,358 | 85.754 | 8,414 | Not yet Efficient |
| Fertilizers | 0,228 | 808,68 | 4.000 | 63,960 | 144.698 | 0,080 | Not Efficient |
| Pesticide | 0,112 | 808,68 | 4.000 | 0,896 | 82.547 | 4,898 | Not yet efficient |
| Labors | 0,182 | 808,68 | 4.000 | 59,490 | 718.867 | 0,014 | Not Efficient |

*Source: Primary data, 2022*

1. Land
   Based on the results of the regression coefficient value of land of 0.303 which is positive, the value of the marginal product (NPMxi) with the price (Pxi) of each production factor is 51.028 and is in the condition of NPMxi / Pxi> 1, so that this value indicates that the land is said to be inefficient. This is because the use of land in the research site is still very small, therefore it is necessary to increase the use of land area so as to increase corn production. According to Setiawan, et al (2012), the allocative efficiency of the use of land production factors, seen from the NPMx / Px ratio of land use of 0.0071655 which is smaller than 1, so that the use of the land area in the research location is allocatively inefficient.
2. Seeds
   Based on the regression coefficient value of the seed of 0.526 which is positive, the value of the marginal product (NPMxi) with the price (Pxi) of each production factor is 8.414 and is in the condition of NPMxi / Pxi> 1, so that this value indicates that the number of seeds used is not efficient. Therefore, it is necessary to increase the use of seeds in order to increase production. According to Susilawati, et al (2015), the allocative efficiency of the use of seed production factors is 1.44 which is greater than 1, so the use of the land area in the research location is allocatively inefficient. Indicating that the average use of seeds of 2.36 kg in 1 hectare in the study area is not efficient, which causes reduced production yields.
3. Fertilizers
   Based on the regression coefficient value of the seed of 0.228 which is positive, the calculation of the marginal product value (NPMxi) and the price (Pxi) of each production factor is 0.080 and is in the condition of NPMxi / Pxi < 1. This shows that the use of fertilizer of 63.96 kg in 1 hectare in the study area is fairly inefficient, which is where the use of fertilizer is not very intensive and not according to the dose and the costs incurred are quite large. So it is necessary to reduce the excessive use of fertilisers and the costs incurred in purchasing fertilisers are also getting smaller. According to Bastanta, ddk 2022, the allocative efficiency of the use of fertiliser production factors can be determined based on the ratio between the marginal product value NPM of the fertilizer production factor and the price or P of the average seasonal land rent per hectare which is 0.97 the value of the ratio is smaller than 1.
4. Pesticide
   Based on the regression coefficient of the seed of 0.112 which is positive, the marginal product value (NPMxi) of each production input and the average price (Pxi) of each production factor is 4.898 and is in the condition of NPMxi/Pxi > 1, which indicates that pesticides are not efficient. So it is necessary to increase the use of pesticides in corn farming activities in order to prevent crop failure due to pests and diseases that damage corn plants so that production increases. According to Puspitasari, et al. (2017) said that the use of the right pesticide dose will control weeds on target, but if the dose is too high it can poison and damage corn plants.
5. Labor
   Based on the regression coefficient value of labour of 0.182 which is positive with the value of the marginal product (NPMxi) and price (Pxi) of each production factor of 0.014 and is in the condition of NPMxi/Pxi < 1, which shows that labour is used inefficiently in corn farming activities. This is due to the excessive use of labour and the costs incurred for labour are too large, so there needs to be a reduction in the use of labour and

the costs incurred are small. The results of this study are in line with the results of Pakasi et al. (2011) which showed that the use of labour production input is inefficient in maize farming in Minahasa Regency.

## 6. CONCLUSIONS AND RECOMMENDATIONS

**Conclusions**

1. Based on the results and discussion above, it can be concluded as follows:
2. Total farmer income from maize farming is Rp.105,460,607 per growing season or Rp. 4,859,936/ha.
3. There are three production factors that significantly affect maize production, namely land area, seeds, and fertilizers, while pesticides and labor have no significant effect.
4. Analysis of allocative efficiency shows that the use of production factors of land, seeds, and pesticides is not yet efficient so their use needs to be increased, while the production factors of fertilizer and labor are inefficient so their use needs to be reduced.

**Recommendations**

1. Maize farmers should continue to cultivate maize crops, and the use of production inputs should be added and also deducted so that the costs incurred in maize farming are as minimal as possible to provide greater income.
2. Related to the use of production factors in maize farming, the use of production factors, especially fertilizer, and labor, needs to be optimized in order to obtain maximum income.
3. To the relevant parties in this case the local government and local agricultural extension workers to continue to assist farmers in providing good and new innovations so that farmers are more productive in agricultural activities.

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